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“On the Propagation of Earthquake Motion to great Distances.”
 By R. D. OLDHAM, Geological Survey of India. Communicated by Sir ROBERT S. BALL, F.R.S. Received June 16,—
 Read November 16, 1899.

(Abstract.)

When preparing a report on the great Indian earthquake of 12th June, 1897, the author noticed that the European records of this earthquake showed a phase of increased disturbance in what are commonly called the preliminary tremors, making, with the great undulations, three phases of motion. He suggested that these three phases represented the arrival of (1) the condensational, (2) the distortional waves travelling through the earth, and (3) surface undulations travelling round the earth. The present paper is an attempt to verify these suggestions by a comparison with other earthquakes.

For this purpose a selection has been made from the published records of those earthquakes which fulfil the conditions (1) that the place of origin shall be known within 1° of arc, (2) that the time of origin shall be known within a limit of error of one minute, (3) that there shall be a sufficient number of records, distant more than 20° of arc from the origin, to serve as a check on each other. Eleven distinct shocks, representing seven great earthquakes, are found to satisfy these conditions, and in every case the same three-phase character as was recognised in the earthquake of 12th June, 1897, is found. A comparison of time intervals and apparent rates of propagation shows

that the coincidence is not accidental, but represents the separation of three distinct types of wave motion having different rates of propagation.

On plotting the records it is found that the time curves of the first two phases form curved lines, indicating an increase of apparent velocity with distance from the origin, such that, applying Rudzki's investigation, the wave motion represented by these two phases must have travelled through the earth, along curved wave paths, convex towards the centre of the earth, and with a rate of propagation which increases with the distance from the surface. On continuing these curves, by extrapolation, to the origin they give rates of propagation in very fair concordance with the rates of propagation of condensational and distortional plane waves which may be expected to obtain in continuous rock at some distance from the surface of the earth.

The waves of the third phase show no such increase of rate of propagation with distance from the origin. The rate of propagation is uniform at all distances; from which it is concluded that the great undulations of the third phase are surface waves, travelling with a uniform rate of propagation round the surface of the earth. It is also found that the waves of this phase set up by great earthquakes travel faster than those set up by lesser ones, and from this it is concluded that the rate of propagation of these waves is in some way a function of their size, thus affording a confirmation of Lord Kelvin's suggestion that their propagation is in part gravitational.

The general conclusion is that in the complete record of a distant earthquake, three distinct types of wave motion can be recognised (1) condensational, and (2) distortional plane waves, travelling by brachistochronic paths through the earth, and (3) elastic, or gravitational elastic, surface waves, travelling round the surface of the earth. The records are, however, often incomplete by the omission of the first or the first and second of these phases, and the widely divergent estimates of the apparent rate of propagation of the preliminary tremors are largely due to this.

“The Medusæ of Millepora.” By SYDNEY J. HICKSON. F.R.S.

Received November 7,—Read November 23, 1899.

Since the discovery of male medusæ in specimens of *Millepora* collected by Professor Haddon in Torres Straits eight years ago (2), I have examined several large collections of specimens, both dried and preserved in spirit, from different parts of the world with the object of comparing the medusæ and the ampullæ they form in the varying forms which the genus exhibits. The examination of the dried corallæ in museums has convinced me that the presence or absence of ampullæ